Validation of MA nuclear data by sample irradiation experiments with the fast reactor JOYO

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Japan Nuclear Cycle Development Institute is developing a commercialized fast reactor cycle system which involves the recycling of minor actinide (MA) nuclides. To develop a burnup calculation method and to validate MA nuclear data, we have launched the isotopic composition analysis of MA samples (^{237}Np, ^{241}Am, ^{243}Am, ^{244}Cm) irradiated at the experimental fast reactor JOYO. The irradiation was performed for 200-250 EFPD during the period of 1994 to 1999. Post irradiation examination (PIE) of the first sample (one of ^{243}Am samples) was finished in October, 2003.

The preliminary analysis on the ^{243}Am sample has been performed. The sample was initially composed of 12.2% of ^{241}Am and 87.8% of ^{243}Am. We focused on the creation of ^{242m}Am from ^{241}Am, as well as that of ^{244}Cm from ^{243}Am. Main purpose of the former one was to validate the isomeric ratio (IR) of ^{241}Am capture reaction. There exist only two IR evaluations with following large discrepancy: about 0.8 (ground/(ground + meta)) given from ENDF/B-VI under fast reactor spectrum, while about 0.7 from JENDL-3.3. This discrepancy influenced strongly on the creation amount of ^{242m}Am. Assuming IR = 0.8 and using JENDL-3.2, we obtained the preliminary C/E value of 1.30 for the abundance ratio of ^{242m}Am/^{241}Am. In the case of IR = 0.85, the C/E value reduced to 1.00. To use other nuclear data libraries (IR was set to 0.85) did not change the C/E value considerably. The experimental error was about 2% via mass spectroscopy, which was small enough. The above results implied the possibility that the IR of ^{241}Am capture reaction is lying around 0.85. This is consistent with the independent PIE results with PFR and PHENIX. Necessity of re-evaluation of the IR both in ENDF/B-VI and in JENDL-3.3 is suggested.

For the abundance ratio of ^{244}Cm/^{243}Am, the present calculations were systematically underestimated by 10-20%. We have met the difficulty in measuring the ratio of Cm/Am, in which relatively large experimental error (about 10%) arose from alpha spectroscopy. We now try to improve the measurement accuracy by means of the isotope dilution analysis.

We carry on the analyses for the remaining samples, increase the number of results, and apply detailed calculation modeling. Those results are to be presented at the conference.

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